Surveys of chimpanzees and other biodiversity in Western Tanzania

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2006

WILDLIFE CONSERVATION SOCIETY

the Jane Goodall Institute

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Financial support

We are very grateful to the following individuals, foundations and US agencies for their support for this work.

Daniel K.Thorne Foundation

Frankfurt Zoological Society

Jane Goodall Institute

John D. and Catherine T. MacArthur Foundation

L.S.B. Leakey Foundation

National Geographic Society

National Science Foundation

United States Fish and Wildlife Service
(Great Apes Conservation Fund)

University of California, San Diego

Wildlife Conservation Society

Acknowledgements

Many people took part in these surveys and it is impossible to thank everyone by name. Dr Andrew Plumptre, David Moyer and Dr Tim Davenport led the field surveys and were ably assisted by team leaders from the Jane Goodall Institute; Shadrack Kamenya, Sood Athumani and Grace Gobbo; the Wildlife Conservation Society; Sammy Sikombe, Hamlet Mugabe, Noah Mpunga, Freddy Massawe, S. Machaga, A.Mwamtobe, S. Kimiti and D. DeLuca; and independent researchers; Moses Mwangoka and Yahaya Abeid. We are grateful for the support of many cooks, field assistants and porters who helped us in the field including Exaud Weraufoo, Hamisi Matama, Tano Pondamali, Masumbuko Hamad, Shabani Musonga and Juma Ramadhani to name a few that were present for a large part of the surveys. We are also grateful for the drivers who managed to negotiate the tricky conditions with great competence and who kept the vehicles moving over very rough terrain; Silas Simwanza, Ezekiel Ndaki, and Liziki Jengela. Dr Lilian Pintea undertook the satellite image analysis of the region to determine the habitat type coverage. Imagery was provided by Jane Goodall Institute. Zoe Balmforth of the Frankfurt Zoological Society (FZS) and Robert Malpas of the Conservation Development Centre (CDC) helped with logistics and support to the surveys in the Mahale National Park.

While in the field we met Hideshi Ogawa who was very helpful in providing us with information about sites he had surveyed, some maps and information about where he had encountered signs of chimpanzees. We used this information to help plan the surveys. Professor Toshisada Nishida was also very encouraging and provided us with a draft paper on nest decay rates from Mahale Mountains National Park. Adriana Hernandez-Aguilar generously contributed her data and expertise on nest distributions in the Issa River area and Professor Jim Moore contributed data from past surveys of Ugalla and Masito and Alex Piel and Fiona Stewart helped collect nest decay data from the Ugalla area. All kindly agreed to write the chapter on this region using data they had collected over the past 10 years for this region. They thank Thune-Paulsen, Yahya Abeid, Moshi Rajabu, Hilali Matama, the late Ramadhani Bilali, Busoti Juma, Mzee Katandasha, and Abdalla Said. Moore's data come from work supported by the LSB Leakey Foundation, National Geographic Society and University of California, San Diego Committee on Research; Hernandez-Aguilar's by grants from the NSF, LSB Leakey Foundation, and Jane Goodall Center at USC.

Mike Wilson and Anthony Collins helped support the surveys by loaning staff from the Jane Goodall Institute in Gombe and we are grateful for their support. James Wakibara and Johannes Balozi from TANAPA had hoped to join us on the surveys but was unable to because of other commitments. However they helped a lot with the planning of the surveys.

CHAPTER 4: Surveys of Ugalla and Masito

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Introduction

The Masito and especially Ugalla regions are uniquely important from a scientific perspective, in that they include among the most arid habitats in which chimpanzees have been studied and as such are important for (a) elucidating the limits to chimpanzee socioecological adaptation, and (b) using our interpretation of those adaptations to better understand early hominid behavioral ecology. Information for this chapter is drawn from multiple sources and spans almost a half-century. In Masito, early research was conducted by members of the Kyoto University African Primatological Expedition (KUAPE) in the mid to late 1960s at Filabanga and Kasakati. Attention has since focused primarily in the Ugalla region. Moore and Ogawa have conducted nearly annual surveys and short studies since 1989. Additionally, Hernandez-Aguilar recently completed dissertation work at Issa, spending 20 consecutive months ending in June 2003. Previously-planned research by Piel and Stewart at Ilumba in 2005 was also incorporated into the larger WCS survey. As might be expected, methodological differences make direct comparisons across these studies and with the 2005 WCS survey difficult; however, with 40-years of study from multiple researchers, we can provide a depth of knowledge that is lacking for other non-National Park areas of Western Tanzania (Suzuki 1969; Kano 1972; Itani 1979; Nishida 1989; Massawe 1992; Moore 1996; Ogawa et al. in review).

Sites surveyed

Information comes from two sites in the Masito region and four in Ugalla (see list below). Habitat is broadly similar over all sites in both areas: Miombo woodland with patches of evergreen forest, mostly riverine. These forest islands have only begun to be studied from the perspective of island refugia and as such are of interest for understanding the origins and extent of current biodiversity patterns.

Masito:

- Filabanga -- Kano (1971) reports on his 11-month study and Moore (unpublished) made a brief survey in 2001; both focused on gallery forest along the Filabanga River and the surrounding Miombo woodlands.
- Kasakati – Several KUAPE researchers have published on aspects of chimpanzee ecology and demography at Kasakati (Izawa 1970, Suzuki 1969) and Moore (unpublished) briefly visited in 2001. The early studies covered hundreds of square kilometers.

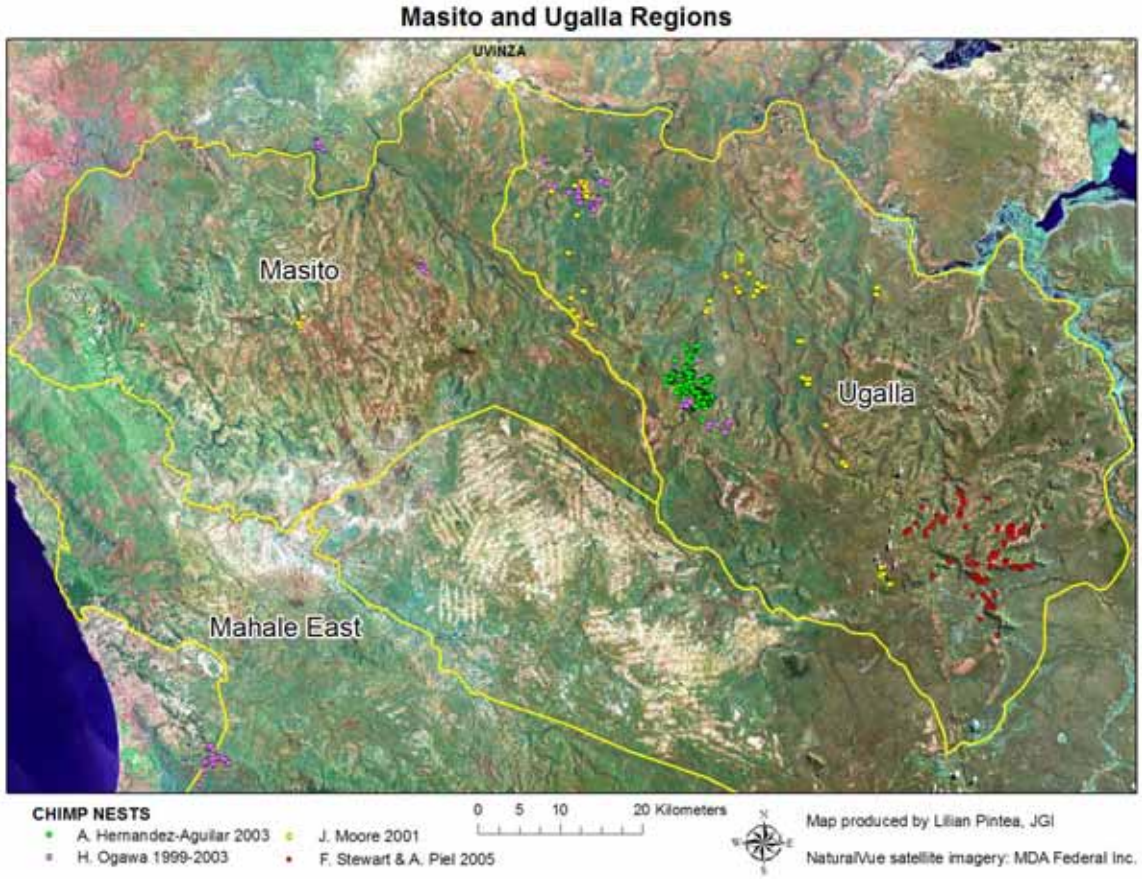
Ugalla:

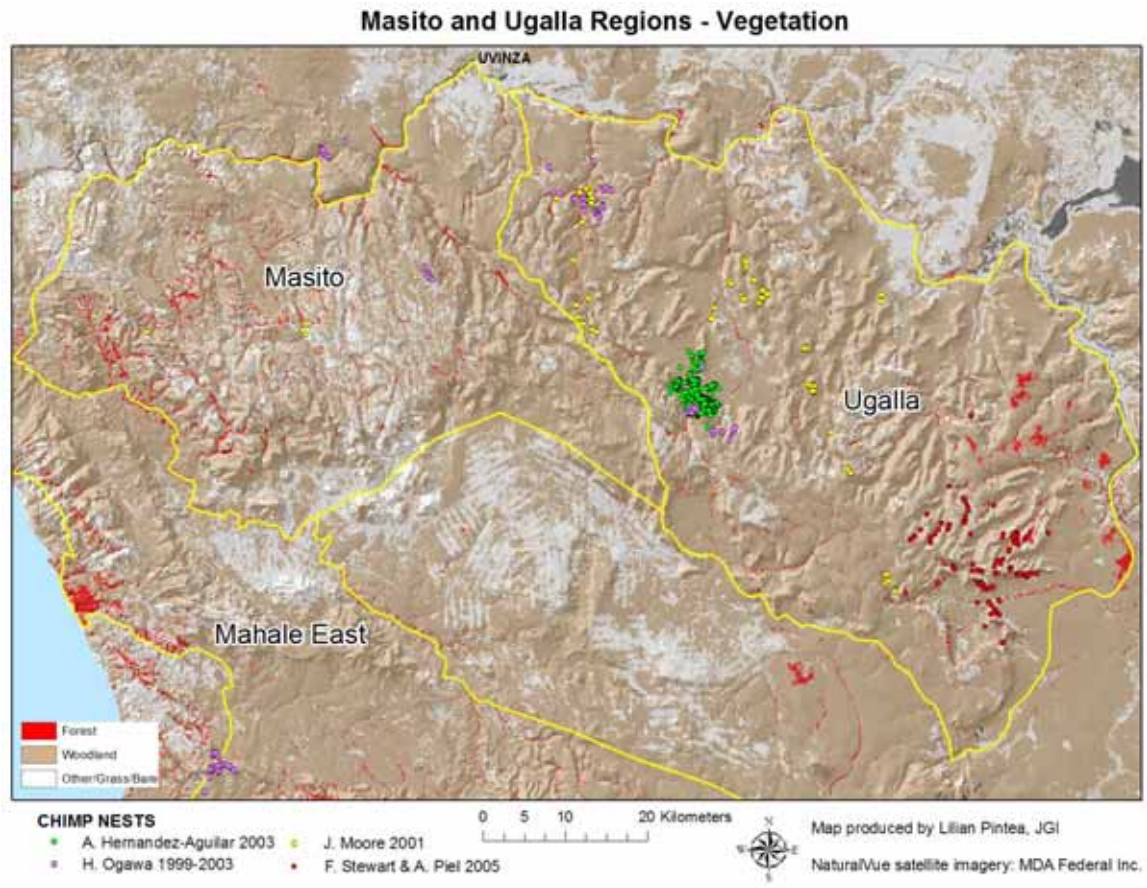
- Nguye – The first campsite south of Uvinza, visited for varying lengths of time by most researchers working in Ugalla. Expansion of shambas southward from Uvinza reached the Nguye River area in about 1997 and chimpanzee use of the site has fallen precipitously since then.
- Issa – Site of dissertation research by Hernandez-Aguilar, on factors influencing chimpanzee choice of nesting sites (cf. comparison with early hominid site placement). Brief surveys by WCS teams and Piel/Stewart in 2005.
- Mttindi/Bhukalai – Extended 'site' studied by Moore (Mttindi) and Ogawa & colleagues (Bhukalai), north and northeast of Issa along the Mogogwesi River.
- Ilumba – Deeply dissected region at the southeast corner of chimpanzee range in Ugalla, surveyed by Piel & Stewart in 2005 and planned site of Piel's dissertation research.

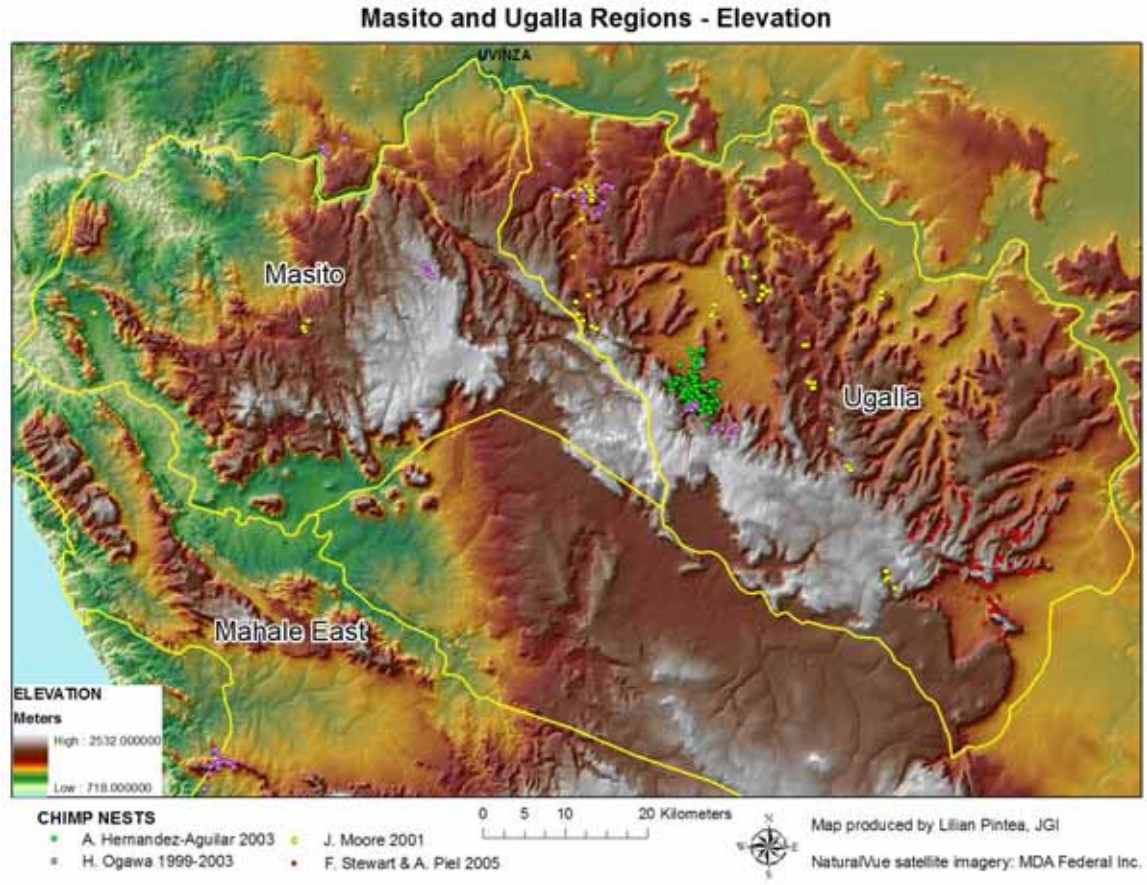
Goals and methods of research varied across sites, with statistically randomized, short, primarily vegetation transects by Moore at Mttindi, Filabanga and Kasakati; longer, less formal walking-route surveys by Ogawa at Nguye and Bhukalai; exhaustive census of

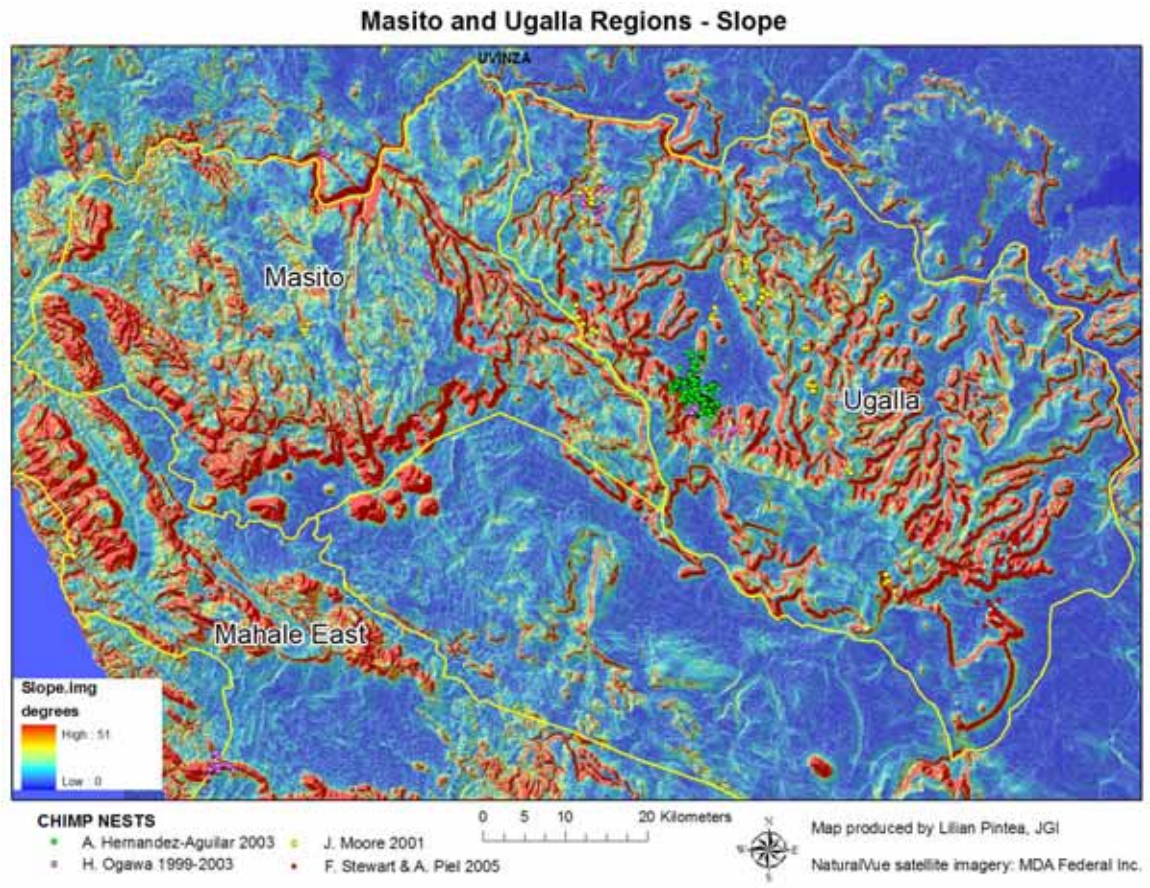
approximately 48 km^2 by Hernandez-Aguilar at Issa; and 30 nest transects stratified by habitat type and topography level by Piel & Stewart within a 625 km^2 area at Ilumba. Chimpanzees of the Masito/Ugalla region make extensive use of woodlands for both feeding (Suzuki 1969; Schoeninger et al. 1999; Hernandez-Aguilar 2006) and nesting (Hernandez-Aguilar 2006, Pintea chap. 8, this Report). Multiple researchers using various methods over four decades in Ugalla have all reported the same pattern (see e.g. Itani 1979: 65), and only during the compilation of this Report did it become apparent that this extensive use of woodlands might be unusual relative to chimpanzees outside of Ugalla (see Chapters 3, 5-7). The reason[s] may be methodological, ecological, geomorphological or a combination of these and perhaps other, not yet identified factors (Kano 1971; see below)

Figure 4.1. Locations of chimpanzee nests in the Masito/Ugalla regions. The yellow line shows the extent of the probable range of chimpanzees within this region. The nests overlay over: a) satellite image 2001-2002, b) forest-woodland classes, c) elevation; d) slope.




Masito and Ugalla Regions - Vegetation
UVINZA
Masito
Ugalla
Mahale East
Forest
Woodland
Other/Grass/Bare
CHIMP NESTS
A. Hernandez-Aguilar 2003
H. Ogawa 1999-2003
J. Moore 2001
F. Stewart & A. Piel 2005
0 5 10 20 Kilometers
Map produced by Lilian Pintea, JGI
NaturalVue satellite imagery: MDA Federal Inc.


Masito and Ugalla Regions - Elevation
UVINZA
Masito
Ugalla
Mahale East
ELEVATION
Meters
High : 2532.000000
Low : 718.000000
CHIMP NESTS
A. Hernandez-Aguilar 2003
H. Ogawa 1999-2003
J. Moore 2001
F. Stewart & A. Piel 2005
0 5 10 20 Kilometers
Map produced by Lilian Pintea, JGI
NaturalVue satellite imagery: MDA Federal Inc.



Methods & Effort

Filabanga (c. 5° 22' S, 30° 09' E) *and Kasakati* (c. 5° 26' S, 29° 57' E): Moore and Y. Abeid made brief visits to these sites in 2001, with the primary goal of vegetation surveys and botanical collection. At each site, four vegetation transects were placed beginning 1km from camp and proceeding away from camp in cardinal directions (NSEW). All four at Filabanga and 2 at Kasakati were the planned 1.5km in length; two Kasakati transects could not be completed in the time available as they ran into dense thicket/forest. Perpendicular distances to all nests observed from transects were recorded, and their ages estimated using standard fresh/recent/old/rotten categories (see Chapter 2). Nest densities were calculated using Kano's (1972) formula:

*Chimpanzees/km^2 = {(# nests seen) * (100/% nests observed)) * (1/nest duration)} / {(transect length) * (transect width/1000)}*

where Kano assumed 70% of nests within 70m of the transect (140m width) were detected. Kano assumed nest duration of 180 days to complete decay (end of stage 4); we used 260 days as the mean time to nest disappearance (Ogawa *et al*. in review). "Kano (1972) method" estimates are *not* corrected for immature non-nest building individuals or production rates ≠ 1.0.

Nguye and Bhukalai: (05°13.0'S, 30°27.5'E & 05°26.8'S, 30°44.1'E); In 1996 – 1997, Ogawa recorded nests observed from "walking routes" in the vicinity of each locality, a total of 98.7 km at Nguye and 80.8 km at Bhukalai. Note that these surveys

predate the arrival of shambas in the Nguye area. Nest densities were calculated using Kano's (1972) method.

Mttindi: (predated GPS; UTM for camp approx. TK 2 370 E 94 115 S); In 1988 Moore did six formal vegetation transects within a 25km^2 square centered on the camp near a small perennial spring. Transects were 2km long and randomly placed (oriented in predetermined cardinal directions from starting points generated by a random numbers calculator and the UTM coordinates on a 1:50,000 map). Perpendicular distances to all nests observed from transects were recorded, and their ages estimated using standard fresh/recent/old/rotten categories (see Chapter two). Nest densities were calculated using Kano's (1972) method.

Issa (5.4245 S, 30.5851 E): Hernandez-Aguilar intensively studied nest distribution in a 48 km^2 area between October 2001 and June 2003. She and her assistants mapped the locations of all observed nests within this area (approx. 5,400), yielding an absolute nest density estimate. Once all nest coordinates have been incorporated into GIS (in collaboration with L. Pintea), it should be possible to sample Issa with "virtual transects"; however such estimates are not yet available and chimpanzee density estimates are based on a modification of the method previously used in Mt. Assirik, Senegal of dividing the mean number of nests found per day by the total number of square kilometers of the sampled area (Baldwin 1979 and Baldwin *et al*. 1982). A total of 5,354 nests were found within the repeatedly sampled area of 48km^2 during 503 days. Since the goal was to count all nests built during a known period of time and because nests of all ages (including decayed or age 4) were recorded, we added the mean time to decay (260 days) to the Baldwin (1979) and Baldwin *et al*. (1982) formula:

Density of chimpanzees (ind/km^2) = (total number of nests/[number of days+mean time to decay])/ km^2 of the sampled area

Ilumba (5.65904 S, 30.9079 E): From August-December 2005 Piel & Stewart made 30 nest transects of 1 to 11 km within a 625km^2 area near the Ilumba River. Transects were stratified according to 2 habitat types (open and closed) and 3 different topographical levels (plateau, slope, valley) with information on GPS, location, and age (in addition to habitat) recorded for each of 654 nests over 82.5 km walked. Perpendicular distances from nests to transect were then entered into the computer program DISTANCE to calculate nest densities in each of the 6 habitat combinations. Chimpanzee densities were then calculated for each habitat type using a mean time for nests to decay to age 4 of 97 days, assuming a production rate of 1.1 in line with this report (see chapter 2). Thus:

Density of Chimpanzees = Density of Nests/(Production rate x mean time to decay).

The resultant densities, 3 within gallery and 3 within woodland, were multiplied by the proportion of slope, valley, and plateau, which were estimated from a topographic map of the study area. L. Pintea (this report) calculated the proportion of gallery and woodland in the Ugalla region to be 2% and 86%, respectively. Under assumption that Ilumba is representative of the greater Ugalla area, these figures were used to control for the proportion of gallery and woodland habitat to reach an overall chimpanzee density estimate for the Ilumba region.

Results:

A total of almost 6,500 nests are included in the density calculations for the seven Masito & Ugalla sites (excluding those used in early published estimates); the sample sizes range from 8 (Mttindi) to over 5,000 (Issa) (see Table 4.1). Because most work at Ugalla has been

directed at locating nests for chimpanzee habitat use and distribution, information on areas lacking nests is limited. In 1993, Moore and J. Sept visited the Bulega area; they found very few nests around the periphery of the basin and concluded that chimpanzees rarely use the indicated area. The exact ecological factors responsible are not known.

Table 4.1 Summary of nest density estimates spanning 40 years of research and the methods used to calculate each estimate. Kilometers of transects walked and number of nests recorded are also provided for each of the 7 seven study sites in the Ugalla/Masito region.

Study Site	**# Nests**	**Mean days to decay**	**# km**	**Density**	**Method**	**Year**	**Researcher / Source**
Filibanga	N/A	N/A	N/A	0.2	Count^	1966	Kano (1971)
Filibanga	25	260	6	0.16	Kano (1972)	2001	Moore
Kasakati	N/A	N/A	N/A	0.49-0.71	Count^	1964-1965	Suzuki (1969)
Kasakati	25	260	3.8	0.26	Kano (1972)	2001	Moore
Masito	N/A	180	N/A	0.17	Count^	1966/67	Kano (1972)
Nguye	146	260	98.7	0.06	Kano (1972)	1999-2000	Ogawa
Bhukalai	134	260	80.8	0.07	Kano (1972)	1999-2000	Ogawa
Mttindi	8	260	12	0.03	Kano (1972)	1988	Moore
Issa	5,354	260	48km^2	0.14	Baldwin et al. (1982)	2001-2003	Hernandez-Aguilar
Ilumba	654	97	82.5	0.06	DISTANCE	2005	Piel & Stewart
Ugalla	350	180	250	0.08	Kano (1972)	1966/67	Kano (1972)
Ugalla	350	*260*	250	0.06	Kano (1972)		Calc. from Kano (1972) data

^ Indicates density based on observational estimate of community size and range

Analyses of chimpanzee nest density

Density estimates for chimpanzees in Masito and Ugalla vary by a factor of >4 (Ugalla: 0.03 to 0.14; Masito: 0.16 to 0.71). However, there is more consistency than is first apparent. First, both the KUAPE estimates from the 1960s and Moore's transect data indicate that chimpanzee density at Kasakati (0.26 – 0.71) is greater than at Filabanga (0.16 – 0.2); i.e., for chimpanzees, "Masito" is heterogeneous at a large scale. At Ugalla, all researchers have noted areas with high concentrations of nests as well as areas largely lacking them. For example, Mttindi is an area used regularly but relatively sparsely for nesting (Moore, personal observations). Conversely, for her study of local-scale chimpanzee nest site preferences, Hernandez-Aguilar selected Issa because the area appears to be a "hot spot". In the absence of more data over greater areas, densities of 0.03 and 0.14 can be

considered approximate minimum and maximum for Ugalla, with other estimates clustering between 0.06 and 0.08/km^2. These estimates and the total area of the Ugalla region as defined in this report (≈3352km^2) suggests an approximate population size of 200 – 270 (range 100 to 650) total chimpanzees; while lacunae exist they are known to be relatively small. Current estimates from Masito (≈2,407 km^2) come from identified study sites so the regional population density is likely to be at the low end of the range; at 0.2/km^2 there would be about 480 chimpanzees (range 385 to 1,700).

Comparison of methods: Density estimates can be calculated from Moore's data with either the Kano (1972) method or DISTANCE, although the samples are far too small to derive an accurate conversion factor. For two sites, the methods yield similar results: Mttindi 0.02 (DISTANCE) and 0.03 (Kano); Kasakati 0.22 (DISTANCE) and 0.26 (Kano). In each case, the Kano-method estimate is slightly greater. However, at Filabanga one transect ran directly into a localized nest concentration that contained all 25 nests recorded at the site; the resulting DISTANCE estimate of 0.49 is three times the Kano-method estimate (confirming the known danger of using DISTANCE with small samples).

Two large samples can be compared, the Ilumba region using DISTANCE with Kano's 1972 overall estimate for Ugalla. When Kano's estimate is recalculated using a 260 day nest duration time, the resulting estimates are effectively the same, at 0.06/km^2. Taken together these comparisons suggest that the two methods are roughly comparable, with the Kano method perhaps superior if sample sizes are small.

Conclusion

Although similar estimates of percentage evergreen forest across the Ugalla/Masito region might initially suggest a homogenous distribution of chimpanzees, GIS analyses and collaboration among researchers have instead revealed the high ecological and topographical variation within these areas (Piel et al. 2006), and consequently, predicted areas of chimpanzee preference (Pintea, Chapter 8 this report). The causes of this variation are unknown, yet could be an artifact of local forest physiognomy-geomorphology interactions (Hernandez-Aguilar 2006; Pintea Chapter 8, this report). Regardless, extensive use of more open habitats is both important (Itani 1979, Schoeninger et al. 1999; Hernandez-Aguilar 2006) and expected given that forest patches make up only 2-3% of the area, with Miombo woodland dominating the landscape (Masito ≈ 76%, Ugalla ≈ 86%).

The Ugalla area is particularly important in terms of ape conservation for several reasons. First, we have population density estimates from the 1960s, 1990s, and 2005, enabling broad tracking of population status over this period. For example, Kano's Ugalla density estimate from the 1960's (0.08) is similar to the more recent range of 0.06 – 0.07 (see Table 4.1), suggesting that chimpanzees have coexisted successfully with small-scale logging, honey collection, and (mostly illegal) hunting. If true, such mixed wildlife-human use of the Miombo woodlands may provide a model for wildlife and forest management outside of Parks that permits local people to continue traditional uses of the forest in harmony with chimpanzees and (most) other wildlife. However, evidence from *all* sites suggests that agricultural expansion and large-scale, local hunting are increasing at rates that may be unsustainable throughout the Ugalla region. If true, remaining chimpanzee populations that have historically lived sympatrically with humans are under severe threat. It should be noted that while there is great overlap, contemporary density estimates tend to be lower than those obtained (by different methods) in the 1960s for both regions; the evidence for decline is especially strong at Kasakati (though the 2001 sample size is far too small to be sure).

Second, their unique scientific value as “savanna chimpanzees” is likely to continue to draw researchers interested in chimpanzees from a paleoanthropological perspective. Already international collaboration has begun to study aspects of the ecology of this region and their

implications for early hominid evolution. In addition to the presence of researchers conferring some degree of protection for local wildlife, the presence of a commercial hunting concession at Ugalla (also called Niensi) further contributes to inter-disciplinary collaboration in the protection of this area. This allows the costs of conserving Ugalla's wildlife to be distributed across a broader constituency than is true for other areas.

Finally, by studying the ecology of Ugalla we can gain an understanding of the minimum requirements to sustain chimpanzees. Such information is essential for understanding whether absence of chimpanzees in other areas is for ecological or anthropogenic reasons. Additionally, long-term research is likely to pay off both with respect to understanding of the Ugalla ecosystem and, simply by the presence of researchers, its protection.

The Masito area is under immediate threat as human population expands southward from the Malagarasi River and eastward from the lake shore. Historically it had large populations of game animals (various KUAPE reports) but these appear to be nearly gone. Access to Kasakati from the lake is easy and the area has real potential for ecotourism, which might help to conserve the remaining wildlife populations.

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Appendix 1. Large Mammals of the Mahale National Park and the Greater Mahale Ecosystem (excluding park). Mammals reported but for which no signs were observed are marked with '?'. Data are from this survey and the literature.

Common Name	Species name	Greater Mahale Ecosystem	Mahale Mountains National park
Primates			
Chimpanzee	*Pan troglodytes schwenfurthii*	1	1
Red Colobus	*Pilioclobus oustaleti tephrosceles*	1	1
Angolan Colobus	*Colobus angolensis*		1
Yellow baboon	*Papio cynocephalus*	1	1
Vervet monkey	*Cercopithecus aethiops pygerythrus*	1	1
Red-tailed Monkey	*Cercopithecus ascanius*	1	1
Blue monkey	*Cercopithecus mitis doggetti*	1	1
Greater galago	*Otolemur crassicaudatus*	1	1
Senegal galago	*Galago senegalensis*	1	1
Dwarf forest galago	*Galagoides sp. To be identified*		1
Bats			
Singing fruit bat	*Epomops franqueti*		1
Epauleted fruit bat	*Epomophorus labiatus*	1	1
Tomb bat	*Taphozous* sp.		1
Serotine bat	*Eptesicus* sp.		1
Shrews			
Chequered elephant shrew	*Rhynchocyon cirnei*	1	1
Rufous elephant shrew	*Elephantulus rufescens*	1	
Four toed elephant shrew	*Petrodromus tetradactylus*	1	
?	*Crodidura sp. 1*		1
?	*Crocidura sp. 2*		1
?	*Sylvisorex sp. 1*		1
Hares/Rabbits			
Cape Hare	*Lepus capensis*	1	1
Rodents			
Sun squirrel	*Heliosciurus sp.*		1
African giant squirrel	*Protoxerus stangeri*		1
African dormouse	*Graphiurus murinus*		1
Crested porcupine	*Hystrix africanus*	1	1
Climbing mouse	*Dendromus nyikae*		1
Giant Pouched rat	*Cricetomys gambianus*	1	1
Common cane rat	*Thryonomys swinderianus*	1	
Common mole rat	*Cryptomys hottentotus*	1	
Groove-toothed rat	*Otomys sp.*		1
Brush-furred mouse	*Lophuromys flavopunctatus*		1
Soft-furred mouse	*Praomys sp.*		1
African Wood mouse	*Hylomyscus*		1
Common mouse	*Mus sp.*		1
Narrow-footed woodland mouse	*Grammomys sp.*		1
Carnivores			
Side-striped jackal	*Canis adustus*	1	1
Wild dog	*Lycaon pictus*	?	1
Zorilla	*Ictonyx striatus*		1
Ratel (Honey badger)	*Mellivora capensis*	1	1

Common Name	Species name	Greater Mahale Ecosystem	Mahale Mountains National park
African clawless otter	*Aonyx capensis*		1
Spot-necked otter	*Lutra maculicollis*		1
Slender mongoose	*Herpestes sanguinea*		1
Dwarf mongoose	*Helogale parvula*	1	1
Banded mongoose	*Mungos mungo*		1
White-tailed mongoose	*Ichneumia albicauda*		1
Bushy-tailed mongoose	*Bdeogale crasicauda*		1
Spotted hyaena	*Crocuta crocuta*	1	1
Common genet	*Genetta genetta*		1
Blotched genet	*Genetta tigrina*		1
Small forest genet	*Genetta sp.*		1
African civet	*Civettictis civetta*	1	1
Serval	*Felis serval*	?	
African wild cat	*Felis sylvestris*		1
Leopard	*Panthera pardus*	1	1
Lion	*Panthera leo*	1	1
Ground pangolin	*Smutsia temminickii*		1
Aardvark	*Orycteropus afer*	1	
Ungulates			
Bush hyrax	*Heterohyrax brucei*		1
Southern Tree hyrax	*Dendrohyrax arboreus*		1
African elephant	*Loxodonta africana*		1
Common zebra	*Equus burchelli*	1	1
Hippopotamus	*Hippopotamus amphibius*		1
Bush pig	*Potamochoerus larvatus*	1	1
Common warthog	*Phacochoerus africanus*	1	1
Giraffe	*Giraffa camelopardalis*		1
African buffalo	*Syncerus caffer*	1	1
Bushbuck	*Tragelaphus scriptus*	1	1
Greater kudu	*Tragelaphus strepsiceros*		1
Eland	*Taurotragus oryx*	1	1
Bush duiker	*Sylvicapra grimmia*	1	1
Blue duiker	*Cephalophus monticola*		1
Suni	*Neotragus moschatus*	1	1
Klipspringer	*Oreotragus oreotragus*	1	1
Southern Reedbuck	*Redunca arundinum*	1	
Waterbuck	*Kobus ellipsiprymnus*	1	1
Topi	*Damaliscus lunatus*		1
Kongoni (Lichenstein's Hartebeest)	*Alcelaphus buselaphus*	1	1
Roan antelope	*Hippotragus equinus*	1	1
Sable antelope	*Hippotragus niger*	?	1